**Pearson BTEC Level 3 Nationals Certificate, Extended Certificate, Foundation Diploma, Diploma, Extended Diploma**

**Please check the examination details below before entering your candidate information**

| Candidate surname | Other names |
|---|---|
| | |

Centre Number | Learner Registration Number

**Time** 40 minutes

**Paper reference** **31617H/1C**

# Applied Science / Forensic and Criminal Investigation

## UNIT 1: Principles and Applications of Science I
## Chemistry
## SECTION B: PERIODICITY AND PROPERTIES OF ELEMENTS

**You must have:**
A calculator and a ruler.

Total Marks

## Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and learner registration number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

## Information

- The exam comprises three papers worth 30 marks each.
  Section A: Structures and functions of cells and tissues (Biology).
  Section B: Periodicity and properties of elements (Chemistry).
  Section C: Waves in communication (Physics).
- The total mark for this exam is 90.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- The periodic table of elements can be found at the back of this paper.

## Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

*Turn over* ▶

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**Answer ALL questions. Write your answers in the spaces provided.**

**Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.**

**1** Lithium and sodium are metals in group 1 of the periodic table.

(a) (i) A physical property of group 1 metals is that they have a low melting point.

Give **one other** physical property of group 1 metals.

**(1)**

.....

(ii) Group 1 elements have a metallic structure.

Figure 1 shows an incomplete diagram of a metallic structure.

Complete Figure 1 by adding positive and negative charges to the diagram.

**(2)**

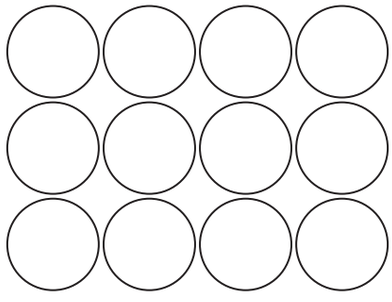

**Figure 1**

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(b) When a piece of sodium is added to water, sodium hydroxide and a gas are produced.

(i) Identify the gas produced.

**(1)**

☒ **A** carbon dioxide

☒ **B** hydrogen

☒ **C** nitrogen

☒ **D** oxygen

(ii) Give **one** use of sodium hydroxide.

**(1)**

.....

.....

(iii) 1.50 g of sodium hydroxide was dissolved in water to make 0.25 $dm^3$ of sodium hydroxide solution.

Calculate the concentration of this solution of sodium hydroxide in g $dm^{-3}$.

**(2)**

Show your working.

concentration = ..... g $dm^{-3}$

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(c) Table 1 shows the first ionisation energies of lithium and sodium.

| group 1 element | first ionisation energy (kJ mol$^{-1}$) |
|---|---|
| lithium | 520 |
| sodium | 496 |

**Table 1**

(i) Complete the equation for the first ionisation energy of sodium.

**(2)**

Na (.....) → $Na^+$ (g) + .....

(ii) Explain why the first ionisation energy of lithium is higher than the first ionisation energy of sodium.

**(3)**

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**(Total for Question 1 = 12 marks)**

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**2** Bromine reacts with iron to form iron(III) bromide.

(a) (i) Identify the structure of iron(III) bromide.

**(1)**

- ☒ **A** giant ionic
- ☒ **B** giant metallic
- ☒ **C** giant molecular
- ☒ **D** simple molecular

(ii) Add numbers to balance the equation for the reaction between iron and bromine.

**(1)**

..... $Fe$ + ..... $Br_2 \rightarrow 2FeBr_3$

(b) Bromine and gallium are in period 4 of the periodic table.

The electronegativity of the elements in period 4 changes across the period.

Explain how the electronegativity changes from gallium to bromine.

**(4)**

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**(Total for Question 2 = 6 marks)**

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**3** (a) Potassium is an element in group 1 of the periodic table.

(i) Identify the electronic configuration of a potassium atom.

**(1)**

☒ **A** $1s^2\ 2s^2\ 2p^6\ 3s^2$

☒ **B** $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

☒ **C** $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$

☒ **D** $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$

(ii) Potassium ions, $K^+$, are formed from potassium atoms.

Describe how a potassium atom forms a potassium ion.

**(2)**

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.....

.....

.....

(b) Potassium chloride can be made by reacting potassium with chlorine.

The equation for the reaction is

$$2K + Cl_2 \rightarrow 2KCl$$

Calculate the mass of potassium needed to make 1.492 g of potassium chloride.

(Relative formula mass of potassium chloride = 74.6)

(Relative atomic mass of potassium = 39.1)

**(3)**

Show your working.

mass of potassium = .....g

**(Total for Question 3 = 6 marks)**

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**4** An iron nail and a copper coin are placed in separate solutions of copper(II) sulfate.

The nail and the coin are removed from the copper(II) sulfate solutions after one hour.

Table 2 shows the recorded observations.

| object | observations |
|---|---|
| iron nail | brown coating, solution loses blue colour |
| copper coin | no coating, solution remains blue |

**Table 2**

Explain, in terms of oxidation and reduction, the observations shown in Table 2.

You may include equations to support your answer.

**(6)**

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**(Total for Question 4 = 6 marks)**

**TOTAL FOR SECTION B = 30 MARKS**

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# The Periodic Table of Elements

| 1 | 2 | | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 (8) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1.0 H hydrogen 1 | | | | | | | | | | (18) 4.0 He helium 2 |
| (1) | (2) | | | | | | | | | | | (13) | (14) | (15) | (16) | (17) | |
| 6.9 Li lithium 3 | 9.0 Be beryllium 4 | | | | | | | | | | | 10.8 B boron 5 | 12.0 C carbon 6 | 14.0 N nitrogen 7 | 16.0 O oxygen 8 | 19.0 F fluorine 9 | 20.2 Ne neon 10 |
| 23.0 Na sodium 11 | 24.3 Mg magnesium 12 | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | 27.0 Al aluminium 13 | 28.1 Si silicon 14 | 31.0 P phosphorus 15 | 32.1 S sulfur 16 | 35.5 Cl chlorine 17 | 39.9 Ar argon 18 |
| 39.1 K potassium 19 | 40.1 Ca calcium 20 | 45.0 Sc scandium 21 | 47.9 Ti titanium 22 | 50.9 V vanadium 23 | 52.0 Cr chromium 24 | 54.9 Mn manganese 25 | 55.8 Fe iron 26 | 58.9 Co cobalt 27 | 58.7 Ni nickel 28 | 63.5 Cu copper 29 | 65.4 Zn zinc 30 | 69.7 Ga gallium 31 | 72.6 Ge germanium 32 | 74.9 As arsenic 33 | 79.0 Se selenium 34 | 79.9 Br bromine 35 | 83.8 Kr krypton 36 |
| 85.5 Rb rubidium 37 | 87.6 Sr strontium 38 | 88.9 Y yttrium 39 | 91.2 Zr zirconium 40 | 92.9 Nb niobium 41 | 95.9 Mo molybdenum 42 | [98] Tc technetium 43 | 101.1 Ru ruthenium 44 | 102.9 Rh rhodium 45 | 106.4 Pd palladium 46 | 107.9 Ag silver 47 | 112.4 Cd cadmium 48 | 114.8 In indium 49 | 118.7 Sn tin 50 | 121.8 Sb antimony 51 | 127.6 Te tellurium 52 | 126.9 I iodine 53 | 131.3 Xe xenon 54 |
| 132.9 Cs caesium 55 | 137.3 Ba barium 56 | 138.9 La* lanthanum 57 | 178.5 Hf hafnium 72 | 180.9 Ta tantalum 73 | 183.8 W tungsten 74 | 186.2 Re rhenium 75 | 190.2 Os osmium 76 | 192.2 Ir iridium 77 | 195.1 Pt platinum 78 | 197.0 Au gold 79 | 200.6 Hg mercury 80 | 204.4 Tl thallium 81 | 207.2 Pb lead 82 | 209.0 Bi bismuth 83 | [209] Po polonium 84 | [210] At astatine 85 | [222] Rn radon 86 |
| [223] Fr francium 87 | [226] Ra radium 88 | [227] Ac* actinium 89 | [261] Rf rutherfordium 104 | [262] Db dubnium 105 | [266] Sg seaborgium 106 | [264] Bh bohrium 107 | [277] Hs hassium 108 | [268] Mt meitnerium 109 | [271] Ds darmstadtium 110 | [272] Rg roentgenium 111 | | | | | | | |

Key

relative atomic mass
**atomic symbol**
name
atomic (proton) number

Elements with atomic numbers 112-116 have been reported but not fully authenticated

* Lanthanide series

* Actinide series

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 140 Ce cerium 58 | 141 Pr praseodymium 59 | 144 Nd neodymium 60 | [147] Pm promethium 61 | 150 Sm samarium 62 | 152 Eu europium 63 | 157 Gd gadolinium 64 | 159 Tb terbium 65 | 163 Dy dysprosium 66 | 165 Ho holmium 67 | 167 Er erbium 68 | 169 Tm thulium 69 | 173 Yb ytterbium 70 | 175 Lu lutetium 71 |
| 232 Th thorium 90 | [231] Pa protactinium 91 | 238 U uranium 92 | [237] Np neptunium 93 | [242] Pu plutonium 94 | [243] Am americium 95 | [247] Cm curium 96 | [245] Bk berkelium 97 | [251] Cf californium 98 | [254] Es einsteinium 99 | [253] Fm fermium 100 | [256] Md mendelevium 101 | [254] No nobelium 102 | [257] Lr lawrencium 103 |

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